



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.   | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|---------------------|------------------|
| 10/707,905  | 01/23/2004  | Douglas D. Coolbaugh | BUR920030177US1     | 1904             |
| 29625   | 7590        | 02/09/2006           | EXAMINER            |                  |
| MCGUIRE WOODS LLP<br>1750 TYSONS BLVD.<br>SUITE 1800<br>MCLEAN, VA 22102-4215 |             |                      | HU, SHOUXIANG       |                  |
|   |             |                      | ART UNIT            | PAPER NUMBER     |
|   |             |                      | 2811                |                  |

DATE MAILED: 02/09/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

|                              |                        |                     |  |
|------------------------------|------------------------|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                              | 10/707,905             | COOLBAUGH ET AL.    |  |
|                              | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                              | Shouxiang Hu           | 2811                |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 06 October 2005.
- 2a) ☐ This action is FINAL.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 16-28 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 16-28 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>11/29/2005</u> . | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Claim Objections***

1. Claims 24-26 are objected to because of the following informalities and/or defects:

In claim 24, the terms of " A>A' " and " B>B' " appear to be in error, as energy and depth are incomparable.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 28 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 28 recites the limitation ""steps a-c are utilized". There is insufficient antecedent basis for this limitation in the claim. And, it is not clear which are the steps a-c in claim 16, which recites at least four process/step items and at least the last one is required for forming the recited anode.

### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

Art Unit: 2811

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 16-18 and 24-28, insofar as being in compliance with 35 U.S.C. 112 and as being best understood in view of the claim objections above, are rejected under 35 U.S.C. 102(b) as being anticipated by Igarashi (Igarashi et al., JP 4-343479, 11/30/1992).

Igarashi discloses a method of fabricating a varactor (see Figs.1 and 2, also see the English abstract), wherein the remaining n-type region 6 (under the p-type region 7) comprises: a first region--the lowest region of the region 6; a second region--the low region of the region 6 that is above and in contact with the lowest region; and, a third region---an upper region of the region 6 that is above the second region (the low region) but below and in contact with the p-type-doped region 7. The method comprises: doping a lower region (the first region of 6) of a substrate layer with a first type of dopants having a dopant profile such that first-energy atoms ("A") therein penetrate to a first depth (" A' ") in the substrate layer, which naturally forms a cathode as it is n-type doped in the diode structure, and with a second-energy atoms ("B") therein penetrate to a second depth (" B' ") in the substrate layer forming a collector region (the second region of the region 6) above the cathode, wherein naturally  $A > B$  and  $A' > B'$ , as they are formed of a same type of implanted dopants, and the second region of the region 6 can naturally function as a collector region as it is formed of an n-type doped region near the PN junction of the diode structure; doping a middle region (the third region of the region 6) of the substrate layer with a second type of dopants, which is naturally tailored

(super-abrupt type) for a to-be-implant profile that forms the anode as it is in direct contact with the to-be-formed anode region (7); and, doping an upper region (7) of the substrate layer that is naturally with a source/drain-type implantation to form the anode region (7) of the diode structure, wherein the doping of the upper region (7; about 40 keV) has less energy than that the other regions (inside region 6; around 70 keV).

Regarding claim 25, the forming of the collector region and the cathode in Igarashi are naturally formed in a single doping step via a natural energy distribution of a single type of dopants.

Regarding claim 26, the active portion of the varactor in Igarashi can be naturally regarded as being formed in a column from the substrate which is semiconductor material.

### ***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 19-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Igarashi in view of AAPA (Applicant admitted prior art).

The disclosure of Igarashi is discussed as applied to claims 16-18 and 24-28 above.

Although Igarashi does not expressly disclose that the method can further comprise the process/steps of forming a bottom layer of the low region with a higher doping concentration, an isolating region, a reach-through implant, and/or a silicide layer, one of ordinary skill in the art would readily recognize that such process/steps are each common in the art for forming desired buried interconnection and/or desired element isolation structure and/or contact to the collector region with reduced connection resistance, as readily evidenced in the prior art, such as AAPA (see the highly doped bottom region 14, the isolation 18, the reach-through region 20, and or, the silicide layer 34).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate process/steps of forming the highly doped bottom layer, isolating region, reach-through implant, and/or silicide layer into the method of Igarashi, per the teachings of AAPA, so that a method for forming a varactor with desired element interconnection, element isolation and/or reduced connection resistance to the collector region would be obtained.

Regarding claims 19 and 20, it is further noted it is art known that a same type dopant can be used for deep and/or shallow implantations for better control of doping profiles; and that higher energy is always required for deeper implantation for the same type dopant.

***Response to Arguments***

5. Applicant's arguments filed on October 10, 2005 have been fully considered but they are not persuasive.

With respect to applicant's arguments regarding Igarashi, the implantation steps therein meet that of the claimed invention, since each of the resulted regions naturally functions respectively as that recited in the rejected claims, and, since each of the resulting implanted regions, especially the n-type region (6) naturally has a dopant distribution along the vertical direction, in which dopants in deep levels naturally possessed higher implanting energy compared to that of the same type dopants but stopped at less deep levels.

Response to the rest of relevant arguments have been incorporated into the claims objections and rejections set forth above in this office action

Applicant's other arguments have been considered but they are moot in view of the new ground(s) of rejection.

***Conclusion***

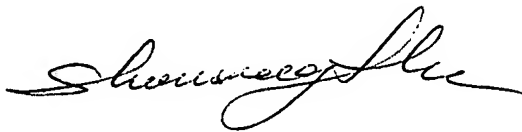
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is 571-272-1654. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

Art Unit: 2811

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

February 3, 2006



**SHOUXIANG HU**  
**PRIMARY EXAMINER**